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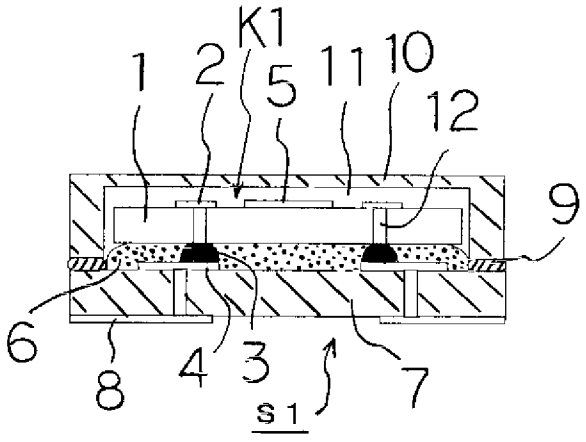
(54)【発明の名称】　弾性表面波装置

(57)【要約】
【課題】　ＳＡＷの振動空間への絶縁性樹脂の入り込みを完全に阻止でき、振動空間を均一な高さ、幅で正確に形成し、その結果、ＳＡＷ装置の特性劣化がなく、また極めて薄型で、小型軽量化が可能で製造容易なＳＡＷ装置を提供すること。
【解決手段】　導体パターン４が形成された絶縁性の基体７上に、弾性表面波を発生させる励振電極５を配設した圧電基板１から成る弾性表面波素子Ｋ１を、励振電極５の配設面を上にした状態で載置したものであって、基体７上の導体パターン４と弾性表面波素子Ｋ１の励振電極５に接続されている入出力端子２とを圧電基板１の両主面に貫通する貫通孔に設けた導体１２を介して接続したことを特徴とする弾性表面波装置Ｓ１とする。



【特許請求の範囲】
【請求項１】　導体パターンが形成された絶縁性の基体上に、弾性表面波を発生させる励振電極を配設した圧電基板から成る弾性表面波素子を、前記励振電極の配設面を上にした状態で載置した弾性表面波装置であって、前記基体上の導体パターンと前記弾性表面波素子の前記励振電極に接続されている入出力端子とを前記圧電基板の両主面に貫通する貫通孔に設けた導体を介して接続したことを特徴とする弾性表面波装置。
【請求項２】　前記基体上の導体パターンと前記圧電基板の下面との間に、導電樹脂を介在させたことを特徴とする請求項１に記載の弾性表面波装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、例えば携帯電話及び自動車電話等の移動体無線機器に内蔵される共振器及び周波数帯域フィルタ用の弾性表面波装置に関する。
【０００２】
【従来の技術】従来の代表的な弾性表面波（Surface Acoustic Wave 、以下ＳＡＷと略す）装置の模式的な切断端面図を図５，６に示す。図５に示すＳＡＷ装置Ｊ１において、Ｈ１はＳＡＷ素子、５１は圧電基板、５２は入出力電極のパッド、５３はパッケージ表面に形成された外部の駆動回路、共振回路、接地回路等に接続される導電パターンのパッド、５４はＳＡＷ素子用の圧電基板上に形成された櫛歯状電極のＩＤＴ（Inter Digital Transducer）電極、５５～５７はセラミック、樹脂等の絶縁性材料からなるパッケージ構成部材、５８はセラミック、金属（コバール、４２合金、Ａｌ、Ｃｕ）等からなる蓋体である。５９はパッド５２、５３を接続するワイヤである。同図の構成では、パッケージ構成部材５５～５７の内部にＳＡＷ素子Ｈ１を接着剤により載置固定し、パッド５２、５３をＡｌ、Ａｕ等のワイヤ５９により電気的に接続し、さらに蓋体５８をはんだ、接着剤等によりパッケージ５７上から接着して気密を保持していた。
【０００３】また、図６に示すＳＡＷ装置Ｊ２において、Ｈ２はＳＡＷ素子、６２は入出力電極のパッド、６３はパッド６２とパッド６４を電気的に接続するバンプ等の接続体、６４は基板６７表面に形成され外部の駆動回路、共振回路、接地回路等に接続される導電パターンのパッド、６５はＳＡＷ素子用の圧電基板上に形成された櫛歯状電極のＩＤＴ電極、６６はＳＡＷ装置全体にモールドされた保護膜としての絶縁性樹脂、６７は、セラミック、樹脂等の絶縁性材料からなる基板である。同図の構成は、ＩＤＴ電極６５が設けられた機能面が基板６７に対面したフェースダウン構成であり、絶縁性樹脂６６が機能面が存在するＳＡＷの振動空間にまで入り込んでいる。
【０００４】図６の接続体６３は、Ａｕ，Ａｌ等の金属のワイヤをボールボンディング法によりバンプとなるよう形成するか、Ａｕ，はんだ等からなるバンプを蒸着法、印刷法、転写法、無電解メッキ法または電解メッキ法等により、パッド６２上に形成して得られる。そして、接続体６３を設けた圧電基板を、接続体６３とパッド６４とを位置合わせして、導電性接着剤の塗布やはんだのリフロー溶融法により接続し、基板６７上に固定する。
【０００５】他の従来構成として、図６とほぼ同様な構成で、絶縁性樹脂６６が振動空間（ＩＤＴ電極存在する空間）に入り込まないように、圧電基板からなるＳＡＷ素子または基板の接続体の振動空間側に、ダムを設けたＳＡＷ装置Ｊ３（不図示）も知られている（例えば、特開平５－５５３０３号公報を参照）。
【０００６】また、パッケージの内部底面に、圧電素子の励振電極の電極パッド上に形成したバンプと高さがほぼ同じ台座を、その端部が圧電素子の外周部と重なるように配設し、バンプをパッケージ内部底面に設けた導電部にフリップチップ法により接続したＳＡＷ装置Ｊ４（不図示）も提案されている（例えば、特開平７－２１２１８１号公報を参照）。
【０００７】さらに、一方の主面に櫛歯状電極と、それに導通しかつ該主面をパッケージ基板の対向面に接触させない程度の高さを有するバンプとが形成されたＳＡＷ素子の他方の面を、接着剤により封止部材に接着するとともに、封止部材を、バンプとパッケージ基板のパッケージ端子とが当接し、かつ、封止部材とパッケージ基板とから形成される空間が封止されるようにパッケージ基板に取り付け、ＳＡＷ素子をパッケージ内に封止したＳＡＷ装置Ｊ５（不図示）も知られている（例えば、特開平６－６１７７８号公報を参照）。
【０００８】
【発明が解決しようとする課題】しかしながら、ＳＡＷ装置Ｊ１においては、ワイヤ５９を使用しているため、ワイヤ５９が存在する横方向と高さ方向の距離の分だけＳＡＷ装置の体積が大きくなり、小型軽量化，薄型化に不利である。また、ワイヤボンディング装置によりワイヤを１本ずつ接続しているので、製造工程が煩雑となる。さらに、ワイヤ５９が存在することにより、不要なインダクタンス成分を付加することになり、ＳＡＷ装置の周波数特性が変化し、設計上それを考慮する手間が生じるという問題があった。
【０００９】また、ＳＡＷ装置Ｊ２においては、絶縁性樹脂６６が振動空間（ＩＤＴ電極６５が存在する空間）に入り込み、ＩＤＴ電極６５が形成されている機能面に接しているため、ＳＡＷの伝搬を阻害しており、ＳＡＷ装置としての所望の特性を得るのが困難である。
【００１０】また、ＳＡＷ装置Ｊ３においては、構造が複雑となったり、絶縁性樹脂６６の入り込みを完全に阻止するには不十分であった。また、前記環状部材を設け

る場合には、振動空間を均一な高さ、幅で正確に形成するのが困難であった。

【００１１】また、ＳＡＷ装置Ｊ４においては、バルク波がＳＡＷ素子の裏面で反射して出力されることを防止するために、ＳＡＷ素子の裏面にダンピング材を配設することが行われ、このダンピング材として、ダイボンド材にその機能を持たせることがあるが、これを行うことができない。さらに、パッケージ内部底面に配設し、蓋体と圧電素子裏面との間に空間を持たせて蓋体により封止する構造であるため、圧電素子と蓋体との空間及び蓋体の高さが必要となり、弾性表面波部品の薄型化において不利な構造である。

【００１２】また、ＳＡＷ装置Ｊ５においては、蓋体側にＳＡＷ素子を接着するためパッケージ端子とバンプのアライメントするかまたは、ＳＡＷ素子を蓋体に接着するときにアライメントをする必要があり、セルフアライメントができない構造のため工程が簡略化できない。また、アライメントのためにパッケージに横方向の余裕が必要となり小型化において不利な構造である。さらには、フェースダウンでフリップチップ実装するため、実装後の検査が困難である。

【００１３】従って、本発明は上記の事情に鑑みて完成されたものであり、その目的はＳＡＷの振動空間への絶縁性樹脂の入り込みを完全に阻止でき、振動空間を均一な高さ、幅で正確に形成し、その結果、ＳＡＷ装置の特性劣化がなく、また極めて薄型で、小型軽量化が可能で製造容易なＳＡＷ装置を提供することにある。

【００１４】

【課題を解決するための手段】上記目的を達成するために、本発明の弾性波装置は、導体パターンが形成された絶縁性の基体上に、弾性表面波を発生させる励振電極を配設した圧電基板から成る弾性表面波素子を、励振電極の配設面を上にした状態で載置したものであって、基体上の導体パターンと弾性表面波素子の励振電極に接続されている入出力端子とを圧電基板の両主面に貫通する貫通孔に設けた導体を介して接続したことを特徴とする。また特に、基体上の導体パターンと前記圧電基板の下面との間に、導電樹脂を介在させたことを特徴とする。

【００１５】

【発明の実施の形態】以下、本発明に係るＳＡＷ装置の実施形態について図面に基づき詳細に説明する。

【００１６】図１～図４はＳＡＷ装置Ｓ１～Ｓ４の実施形態の切断端面図である。尚、図１～４において、同じ部材には同一の符号を付している。

【００１７】図１において、Ｋ１はＳＡＷ素子、１は圧電基板、２は後記するＩＤＴ電極に接続されるＳＡＷ素子Ｋ１の入出力端子である入出力電極パッド、３はバンプ等の電気的な接続体、４は後記する絶縁性基板（基体）７上に設けられ、外部に導通され、接続体３に接続される導電パターン８に貫通導体（スルーホールまたはビアホール）で接続されたパッド（導体パターン）、５は励振電極であるＩＤＴ電極、６は絶縁性樹脂、７はセラミック，樹脂等からなる絶縁性基板（基体）、８は外部の駆動回路、共振回路、接地回路等に接続され絶縁性基板７に設けられたリードパターンである。９は絶縁性基板７とキャップ１０を接続する絶縁性樹脂である。１０はセラミック，樹脂，金属（コバール，４２合金，Ａ１，Ｃｕ等）等からなるキャップである。１１はＩＤＴ電極５の振動空間である。１２は入出力電極パッド２と接続体３とを導通するために、圧電基板１の両主面に貫通する貫通孔に設けた導体である。

【００１８】ＳＡＷ素子Ｋ１は、互いに噛み合うように形成された少なくとも一対の櫛歯状電極のＩＤＴ電極５を設けることにより作製される。ＩＤＴ電極５は、所望の特性を得るために、複数対の櫛歯状電極を、直列接続，並列接続，縦続接続等の方式で接続して構成してもよい。

【００１９】絶縁性基板７は、例えばセラミック基板または、セラミック基板と枠状セラミック基板とを積層することによって作製するか、または樹脂，ガラス等の基板の一主面を、エッチング法，フォトリソグラフィ法とエッチング法，機械的研削法またはレーザー加工法等により加工して容易に形成できる。

【００２０】導体１２は、ＹＡＧレーザー，炭酸ガスレーザー，エキシマレーザー等によるレーザー加工法等により加工して形成した後、銀ペースト等の導電ペーストを充填して形成する。

【００２１】ＩＤＴ電極５は蒸着法、スパッタリング法またはＣＶＤ法等の薄膜形成法により形成する。

【００２２】また、接続体３は、Ａｕ，Ａ１等の金属のワイヤをボールボンディング法によりバンプとなるように形成するか、Ａｕ，はんだ等からなるバンプを蒸着法、印刷法、転写法、無電解めっき法または電解めっき法等により、導体パターン４上に形成することによって得られる。

【００２３】その後、ＩＤＴ電極５が設けられた圧電基板の裏面を、導体１２を介して接続体３を設けた導体パターン４に、導電性接着剤、超音波併用熱圧着法等により電気的に導通させて接続し、ＳＡＷ素子Ｋ１を絶縁性基板７に固定する。このとき、導体１２を導体パターン４の接続体３に当接させた状態で、絶縁性樹脂６により固定するようにしても構わない。

【００２４】そして、ＳＡＷ素子Ｋ１の裏面を絶縁性基板７にダイボンド材となる絶縁性樹脂６を介して接着固定される。

【００２５】また、絶縁性樹脂６の材料としては、熱硬化性のエポキシ樹脂，シリコーン樹脂，フェノール樹脂，ポリイミド樹脂，低融点ガラス及び熱可塑性ポリフェニレンサルファイド等が用いられるが、特にエポキシ樹脂が接着性，低吸湿性，電気絶縁性，機械的強度，耐

薬品性，耐熱性の点で好ましい。

【００２６】最後に、ＳＡＷ素子Ｋ１を載置したセラミック製の絶縁性基板７とキャップ１０を、絶縁性樹脂９により接着固定し、絶縁性樹脂６がＩＤＴ電極５が形成された機能面に浸入しない構成とし、ＳＡＷ装置Ｓ１を完成する。

【００２７】また、圧電基板１の導体１２と接続体３を形成した導電パターン４との接続と、上記絶縁性基板７の接続は絶縁性樹脂６の加熱接続により同時に行ってもよい。

【００２８】また、電気的な接続体３は、必ずしも導電パターン４上に形成せずともよく、ＳＡＷ素子Ｋ１側に設けてもよい。以下、各図の構成について説明する。

【００２９】図１～４は、ＳＡＷ素子Ｋ１の圧電基板１に貫通導体１２を形成し、従来構造と同様にフェースアップ構造により絶縁性基板７または後記する絶縁性パッケージ１４に実装したものである。

【００３０】図２は、図１の応用例でＳＡＷ素子Ｋ２と絶縁性パッケージ１４の接続に、ダイボンド材と接続材料の役割を兼ねた異方性導電樹脂１３を用いた構造となっている。また、異方性導電樹脂１３としては、銀フィラーを混入させたエポキシ樹脂等が用いられる。この異方性導電樹脂１３を用いることにより縦方向に導通を生じさせている。１５は、セラミック，樹脂金属（コバール，４２合金，Ａ１，Ｃｕ等）等からなる蓋体である。１４はセラミック，樹脂等の絶縁性材料からなるパッケージである。ＳＡＷ素子Ｋ２を載置したセラミック製絶縁性パッケージ１４と蓋体１５を、シーム溶接またはＡｕ－Ｓｎ系半田等の接着材１６により接着固定し、従来のように絶縁性樹脂がＩＤＴ電極５が形成された機能面に浸入しない構成とし、ＳＡＷ装置Ｓ２を完成する。なお、図１と同様に、絶縁性基板７とキャップ１０を用いる構造で実装してもかまわない。

【００３１】図３は、図２の変形例のＳＡＷ装置Ｓ３であって、ＳＡＷ素子Ｋ３の入出力パッド２を圧電基板１の裏面で、導体１２を介して接続体３を設けた導体パターン４に、超音波併用熱圧着法等により電気的に導通させて接続し、接着固定した構造になっている。これもまた、図１と同様に、絶縁性基板７とキャップ１０を用いる構造で実装してもかまわない。

【００３２】図４は、ＳＡＷ素子Ｋ４を構成するＩＤＴ電極５を覆うように、絶縁性樹脂６が機能面に侵入することを防ぐため、セラミック，樹脂，金属等からなる保護カバー１７を絶縁性樹脂等で接続し、ＳＡＷ素子Ｋ４を図１と同様な方法で、セラミック，樹脂等の絶縁性材料からなる基板７と接続した後、保護膜としてＳＡＷ装置Ｓ４全体に絶縁性樹脂６をモールドした構造となっている。

【００３３】このように、図２，図３のＳＡＷ装置は、いずれも位置合わせがセルフアライメントでＳＡＷ素子を落とし込むことができる。図１～図４は、絶縁性樹脂がＩＤＴ電極の振動空間に入り込まない確実な気密構造が得られる。

【００３４】図１～図４において、振動空間内に低湿度の空気を封入し密閉することにより、ＩＤＴ電極５の酸化による劣化を抑制でき好ましい。また、空気の代わりに、窒素ガスやアルゴンガスなどの不活性ガス等を封入し密閉しても、同様な効果が得られる。

【００３５】本発明において、ＩＤＴ電極５はＡｌあるいはＡｌ合金（Ａｌ－Ｃｕ系、Ａｌ－Ｔｉ系等）からなり、特にＡｌが励振効率が高く、材料コストが低いため好ましい。また、ＩＤＴ電極５の形状は、互いに噛み合うように形成された櫛歯状であるが、複数の電極指を平行に配列した反射器のようなスリット型のものにも適用でき、それらを併用したタイプであってよい。

【００３６】そして、ＩＤＴ電極５の対数は５０～２００程度、電極指の幅は０．１～１０．０μｍ程度、電極指の間隔は０．１～１０．０μｍ程度、電極指の交差幅は１０～８０μｍ程度、ＩＤＴ電極５の厚みは０．２～０．４μｍ程度とすることが、共振器あるいはフィルタとしての所期の特性を得るうえで好適である。また、ＩＤＴ電極５のＳＡＷの伝搬路の両端に、ＳＡＷを反射し効率よく共振させるための反射器を設けてもよく、さらには、電極指間にＺｎＯ等の圧電材料を成膜すれば、ＳＡＷの共振効率が向上し好適である。

【００３７】また、ＩＤＴ電極５のＳＡＷの伝搬路の両端に、ＳＡＷを反射し効率よく共振させるための反射器を設けてもよく、さらには、電極指間にＺｎＯ等の圧電材料を成膜すれば、ＳＡＷの共振効率が向上し好適である。

【００３８】ＳＡＷ素子用の圧電基板としては、３６°Ｙカット－Ｘ伝搬の$LiTaO_3$単結晶、６４°Ｙカット－Ｘ伝搬の$LiNbO_3$単結晶、４５°Ｘカット－Ｚ伝搬のLiB_4O_7単結晶は電気機械結合係数が大きく且つ群遅延時間温度係数が小さいため好ましい。また、圧電基板の厚みは０．３～０．５ｍｍ程度がよく、０．３ｍｍ未満では圧電基板が脆くなり、０．５ｍｍ超では材料コストが大きくなる。

【００３９】かくして、本発明は、ＳＡＷの振動空間への絶縁性樹脂の入り込みを完全に阻止でき、振動空間を確実に形成し、その結果、ＳＡＷ装置の特性劣化がなく、また薄型化及び小型軽量化され、さらには低コストで製造可能となるという作用効果を有する。

【００４０】なお、本発明は上記の実施形態に限定されるものではなく、本発明の要旨を逸脱しない範囲内で種々の変更は何等差し支えない。

【００４１】

【実施例】図１に示す弾性表面波装置Ｓ１を以下のように構成した。ＳＡＷ素子用の圧電基板として３６°Ｙカット－Ｘ伝搬の$LiTaO_3$単結晶を用い、そのチップ

サイズを１．１ｍｍ×１．５ｍｍとした。また、絶縁性パッケージとして３．０ｍｍ×３．０ｍｍ、導電パターンを合計１μｍ膜厚のＡｕ及びＮｉを無電解めっきにて形成した。絶縁性パッケージは高さ０．８ｍｍのアルミナ製パッケージを使用した。

【００４２】接続体はＡｕのワイヤーをボールボンディング法によりバンプとなるように上記導電パターン上に形成した。このバンプ径は７０μｍ、高さは５０μｍとした。

【００４３】圧電基板の両主面に貫通する貫通孔に設けた導体は、炭酸ガスレーザーを用いて加工し、孔径２０μｍの孔を形成した後、銀ペーストを充填して形成した。

【００４４】バンプとＳＡＷ素子の導体との接続は、Ａｇを含む熱硬化性のエポキシ系導電性接着剤をバンプ３に転写塗布し、ＳＡＷ素子と絶縁性基板を窒素雰囲気中で１００℃で加熱接着した。最後に、キャップを絶縁性基板にエポキシ系接着剤により１５０℃で加熱接着した。

【００４５】このような工程で作製した弾性表面波装置の高さは１．３ｍｍとなった。以上のように、従来のワイヤボンディング工程が不要となり、ワイヤの横方向の空間及びワイヤの高さ方向のサイズを縮小でき、小型化・薄型化を図ることができた。

【００４６】ＲＦ－ＳＡＷフィルターを従来のセラミックパッケージに実装するとベアチップエレメントと比較して高周波側の減衰量が著しく劣化する。また、通過帯域内の低周波側の減衰特性がフィルター仕様により劣化することがある。これは、パッケージ及びＡｕワイヤのインダクタンス成分による影響と考えられる。フリップチップ実装を適用することにより、ベアチップエレメント特性に近いフィルターの周波数特性が得られると考えられる。

【００４７】

【発明の効果】以上詳述したように、本発明の弾性表面波装置によれば、基体上の導体パターンと弾性表面波素子の励振電極に接続されている入出力端子とを、圧電基板の両主面に貫通する貫通孔に設けた導体を介して接続したので、弾性表面波の振動空間の気密を確実に形成できるので、振動空間への絶縁性樹脂、ほこり等の入り込みを完全に阻止し、また、特性劣化を極力防止した信頼性に優れた弾性表面波装置を提供できる。

【００４８】また、圧電基板とほぼ同じ底面積を有する絶縁性基板または絶縁性パッケージ内に圧電基板を載置，固定するので、薄型化及び小型化を図ることができ、しかも、絶縁性パッケージに圧電基板を載置する場合は、セルフアライメントで精度良く実装できる弾性表面波装置を提供できる。

【００４９】さらに、フェースアップ構造で実装できるので、接続した後でも外観等を検査でき、製造容易な弾性表面波装置を提供できる。

【図面の簡単な説明】

【図１】本発明に係る弾性表面波装置の一実施形態を模式的に説明するための端面図である。

【図２】本発明に係る弾性表面波装置の他の実施形態を模式的に説明するための端面図である。

【図３】本発明に係る弾性表面波装置の他の実施形態を模式的に説明するための端面図である。

【図４】本発明に係る弾性表面波装置の他の実施形態を模式的に説明するための端面図である。

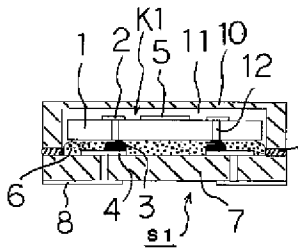
【図５】従来の弾性表面波装置を模式的に説明するための端面図である。

【図６】従来の他の弾性表面波装置を模式的に説明するための端面図である。

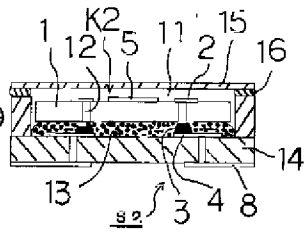
【符号の説明】

１：圧電基板
２：パッド
３：接続体（バンプ）
４：導電パターン
５：ＩＤＴ電極
６：絶縁性樹脂
７：絶縁性基板（基体）
８：電極リードパターン
９：絶縁性樹脂
１０：キャップ
１１：振動空間
１２：導体
１３：異方性導電樹脂
１４：絶縁性パッケージ
１５：蓋体（リッド）
１６：リッド接続体
１７：保護カバー
Ｋ１～Ｋ４：ＳＡＷ素子
Ｓ１～Ｓ４：ＳＡＷ装置

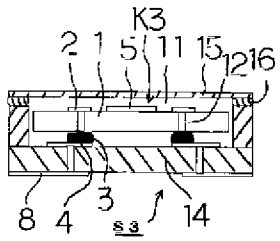
【図1】



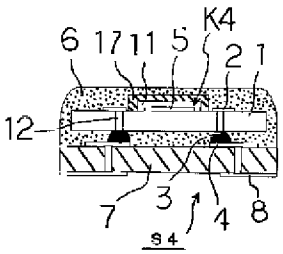
【図2】



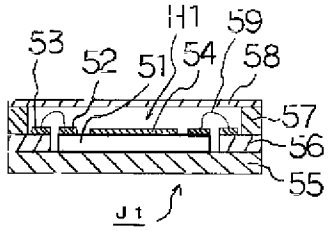
【図3】



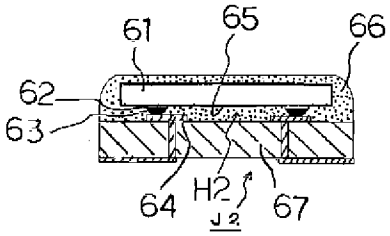
【図4】



【図5】



【図6】



PATENT ABSTRACTS OF JAPAN

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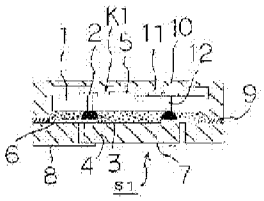
(22)Date of filing : **30.09.1999** (72)Inventor : **IIOKA ATSUHIRO**

(54) **SURFACE ACOUSTIC WAVE DEVICE**



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a SAW device which is free of characteristic deterioration and very thin and can be made small-sized and lightweight and manufactured with ease by completely stopping insulating resin from entering a vibration space of SAW and forming the vibration space at uniform height to accurate width.

SOLUTION: A surface acoustic wave element K1 composed of a piezoelectric substrate 1 having an excitation electrode 5 for generating a surface acoustic wave arranged on an insulating base 7 where a conductor pattern 4 is formed is mounted with an arrangement surface of the excitation electrode 5 up and the

conductor pattern 4 on the base 7 and an input/output terminal 2 connected to the excitation electrode 5 of the surface acoustic wave element K1 are connected through a conductor 12 provided in a through hole penetrating the piezoelectric substrate 1 between both the main surfaces, so that the surface acoustic wave device S1 is constituted.

LEGAL STATUS

[Date of request for examination]

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[Date of final disposal for application]

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[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The surface acoustic element which consists of the piezo-electric substrate which arranged the excitation electrode made to generate a surface acoustic wave on the insulating base with which the conductor pattern was formed It is surface acoustic wave equipment which laid the arrangement side of said excitation electrode in the condition of having turned up. Surface acoustic wave equipment characterized by connecting through the conductor which prepared the input/output terminal connected to the conductor pattern on said base, and said excitation electrode of said surface acoustic element in the through tube penetrated to both the principal planes of said piezo-electric substrate.

[Claim 2] Surface acoustic wave equipment according to claim 1 characterized by making electric conduction resin intervene between the conductor pattern on said base, and the inferior surface of tongue of said piezo-electric substrate.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the surface acoustic wave equipment for a resonator and frequency band filters built in mobile wireless devices, such as a cellular phone and a land mobile radiotelephone.

[0002]

[Description of the Prior Art] The typical amputation stump side Fig. of conventional typical surface acoustic wave (it omits Surface Acoustic Wave and Following SAW) equipment is shown in drawing 5 and 6. In the SAW equipment J1 shown in drawing 5 a SAW component and 51 H1 A piezo-electric substrate, The drive circuit of the exterior where 52 was formed in the pad of an I/O electrode and 53 was formed in the package front face, The pad of the electric conduction pattern connected to a resonance circuit, a grounded circuit, etc., the IDT (Inter Digital Transducer) electrode of the ctenidium-like electrode with which 54 was formed on the piezo-electric substrate for SAW components, The package configuration member which 55-57 become from insulating ingredients, such as a ceramic and resin, and 58 are lids which consist of a ceramic, a metal (covar, 42 alloys, aluminum, Cu), etc. 59 is a wire which connects pads 52 and 53. With the configuration of this drawing, installation immobilization of the SAW component H1 was carried out with adhesives inside the package configuration members 55-57, pads 52 and 53 were electrically connected with the wires 59, such as aluminum and Au, the lid 58 was further pasted up from the package 57 with solder, adhesives, etc., and the airtight was held.

[0003] In the SAW equipment J2 shown in drawing 6 a SAW component and 62 H2 Moreover, the pad of an I/O electrode, Connection objects to which 63 connects a pad 62 and a pad 64 electrically, such as a bump, The pad of the electric conduction pattern which 64 is formed in substrate 67 front face, and is

connected to an external drive circuit, a resonance circuit, a grounded circuit, etc., The IDT electrode of the ctenidium-like electrode with which 65 was formed on the piezo-electric substrate for SAW components, the insulating resin as a protective coat with which the mold of 66 was carried out to the whole SAW equipment, and 67 are substrates which consist of insulating ingredients, such as a ceramic and resin. The configuration of this drawing is a face down configuration with which the functional side in which the IDT electrode 65 was formed met the substrate 67, and insulating resin 66 has entered even the oscillating space of SAW where a functional side exists.

[0004] The connection object 63 of drawing 6 forms the bump who forms the wire of metals, such as Au and aluminum, so that it may become a bump by the ball bonding method, or consists of Au, solder, etc. on a pad 62 with vacuum deposition, print processes, a replica method, an electroless deposition method, or electrolysis plating, and is acquired. And alignment of the connection object 63 and the pad 64 is carried out, the piezo-electric substrate which established the connection object 63 is connected with the reflow scorification of spreading of electroconductive glue, or solder, and it fixes on a substrate 67.

[0005] As other conventional configurations, the SAW equipment J3 (un-illustrating) which established the dam in the oscillating space side of the connection object of the SAW component or substrate which consists of a piezo-electric substrate is also known for the almost same configuration as drawing 6 so that insulating resin 66 may not enter oscillating space (space which recognizes IDT electrode existence) (see JP,5-55303,A).

[0006] Moreover, the plinth with almost same bump and height which were formed on the electrode pad of the excitation electrode of a piezoelectric device is arranged in the internal base of a package so that the edge may lap with the periphery section of a piezoelectric device, and the SAW equipment J4 (un-illustrating) connected to the current carrying part which prepared the bump in the interior base of a package by the flip chip method is also proposed (see JP,7-212181,A).

[0007] Furthermore, while pasting a closure member with adhesives, the field of another side of a SAW component in which the bump who has the height of extent which it flows [extent] in one principal plane at a ctenidium-like electrode and it, and does not contact this principal plane to the opposed face of a package substrate was formed A bump and the package terminal of a package substrate contact a closure member. And it attaches in a package substrate so that the closure of the space formed from a closure member and a package substrate may be carried out, and the SAW equipment J5 (un-illustrating) which closed the SAW component in the package is also known (see JP,6-61778,A).

[0008]

[Problem(s) to be Solved by the Invention] However, in SAW equipment J1, since the wire 59 is used, only the part of the distance of the longitudinal direction where a wire 59 exists, and the height direction becomes large, and its volume of SAW equipment is disadvantageous for the formation of small lightweight, and thin-shape-izing. Moreover, since it has connected one wire at a time with wirebonding equipment, a production process becomes complicated. Furthermore, when a wire 59 existed, an unnecessary inductance component will be added, the frequency characteristics of SAW equipment changed, and there was a problem that the time and effort which takes it into consideration on a design arose.

[0009] Moreover, in SAW equipment J2, it is difficult for insulating resin 66 to have entered oscillating space (space where the IDT electrode 65 exists), to have checked propagation of SAW, since it is in contact with the functional side in which the IDT electrode 65 is formed, and to acquire the desired property as SAW equipment.
 [0010] Moreover, in SAW equipment J3, structure was inadequate for becoming complicated or preventing an enter lump of insulating resin 66 completely. Moreover, when preparing said annular member, it was difficult to form oscillating space correctly by uniform height and width of face.

[0011] Moreover, in SAW equipment J4, although arranging a damping material in the rear face of a SAW component is performed and that function may be

given to die bond material as this damping material in order to prevent that a bulk wave reflects and is outputted with the rear face of a SAW component, this cannot be performed. Furthermore, since it is the structure which arranges in the interior base of a package, gives space between a lid and a piezoelectric-device rear face, and is closed with a lid, the space of a piezoelectric device and a lid and the height of a lid are needed, and it is disadvantageous structure in thin-shape-izing of surface acoustic wave components.

[0012] Moreover, in order to paste up a SAW component on a lid side, when [which is a bump] carrying out alignment or pasting up a SAW component on a lid, it is necessary to a package terminal to carry out alignment, and in SAW equipment J5, since it is the structure whose self-alignment is impossible, a process cannot be simplified. Moreover, lateral allowances are needed for a package for alignment, and it is disadvantageous structure in a miniaturization. Furthermore, in order to carry out flip chip mounting by face down, the inspection after mounting is difficult.

[0013] therefore, this invention is completed in view of the above-mentioned situation -- having -- the purpose -- an enter lump of the insulating resin to the oscillating space of SAW -- perfect -- it can prevent -- oscillating space -- uniform height and width of face -- exact -- forming -- consequently, property degradation of SAW equipment -- there is nothing -- moreover -- very -- a thin shape -- it is -- the formation of small lightweight -- possible -- manufacture -- it is in offering easy SAW equipment.

[0014]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the elastic wave equipment of this invention The surface acoustic element which consists of the piezo-electric substrate which arranged the excitation electrode made to generate a surface acoustic wave on the insulating base with which the conductor pattern was formed It is characterized by having laid in the condition of having turned the arrangement side of an excitation electrode up, and connecting through the conductor which prepared the input/output terminal connected to the

conductor pattern on a base, and the excitation electrode of a surface acoustic element in the through tube penetrated to both the principal planes of a piezo-electric substrate. Moreover, it is characterized by making electric conduction resin intervene especially between the conductor pattern on a base, and the inferior surface of tongue of said piezo-electric substrate.

[0015]

[Embodiment of the Invention] Hereafter, the operation gestalt of the SAW equipment concerning this invention is explained to a detail based on a drawing.

[0016] Drawing 1 - drawing 4 are the amputation stump side Figs. of the operation gestalt of SAW equipment S1 - S4. In addition, in drawing 1 -4, the same sign is given to the same member.

[0017] The I/O electrode pad which is connected to the IDT electrode with which K1 carries out a SAW component and 1 carries out the postscript of a piezo-electric substrate and 2 in drawing 1 and which is the input/output terminal of the SAW component K1, Connection objects with electric 3, such as a bump, and 4 are prepared on the insulating substrate (base) 7 which carries out a postscript. the electric conduction pattern 8 which flows outside and is connected to the connection object 3 -- penetration -- the pad (conductor pattern) connected with the conductor (a through hole or beer hall) -- They are the IDT electrode whose 5 is an excitation electrode, the insulating substrate (base) with which insulating resin and 7 consist of a ceramic, resin, etc. in 6, and the lead pattern which 8 was connected to the external drive circuit, the resonance circuit, the grounded circuit, etc., and was prepared in the insulating substrate 7. 9 is insulating resin which connects cap 10 with the insulating substrate 7. 10 is a cap which consists of a ceramic, resin, metals (covar, 42 alloys, aluminum, Cu, etc.), etc. 11 is the oscillating space of the IDT electrode 5. Since it flows through the I/O electrode pad 2 and the connection object 3, 12 is the conductor prepared in the through tube penetrated to both the principal planes of the piezo-electric substrate 1.

[0018] The SAW component K1 is produced by [which form the IDT electrode 5 of the ctenidium-like electrode of a pair at least] having been formed so that it

might gear mutually. The IDT electrode 5 may connect and constitute two or more pairs of ctenidium-like electrodes from methods, such as series connection, parallel connection, and cascade connection, in order to acquire a desired property.

[0019] The insulating substrate 7 is produced by carrying out the laminating of a ceramic substrate, or a ceramic substrate and a frame-like ceramic substrate, or processes one principal plane of substrates, such as resin and glass, with the etching method, the photolithography method and the etching method, a mechanical grinding method, or a laser process, and can form it easily.

[0020] After processing a conductor 12 with the laser process by the YAG laser, carbon dioxide laser, an excimer laser, etc. and forming it, it fills up with and forms conductive paste, such as a silver paste.

[0021] The IDT electrode 5 is formed by the thin film forming methods, such as vacuum deposition, the sputtering method, or a CVD method.

[0022] Moreover, the connection object 3 is acquired by forming the bump who forms the wire of metals, such as Au and aluminum, so that it may become a bump by the ball bonding method, or consists of Au, solder, etc. on a conductor pattern 4 by vacuum deposition, print processes, the replica method, the nonelectrolytic plating method, or the electrolysis galvanizing method.

[0023] Then, the conductor pattern 4 which established the connection object 3 through the conductor 12 is made to flow through the rear face of a piezo-electric substrate in which the IDT electrode 5 was formed electrically by electroconductive glue, ultrasonic concomitant use thermocompression bonding, etc., it connects, and the SAW component K1 is fixed to the insulating substrate 7. You may make it fix a conductor 12 with insulating resin 6 in the condition of having made the connection object 3 of a conductor pattern 4 contacting, at this time.

[0024] And adhesion immobilization is carried out through the insulating resin 6 which becomes the insulating substrate 7 with die bond material about the rear face of the SAW component K1.

[0025] Moreover, as an ingredient of insulating resin 6, although an epoxy resin, silicone resin, phenol resin, polyimide resin, thermosetting low melting glass, thermosetting thermoplastic polyphenylene sulfide, etc. are used, especially an epoxy resin is desirable an adhesive property, low hygroscopicity, electric insulation, a mechanical strength, chemical resistance, and in respect of thermal resistance.

[0026] Finally, adhesion immobilization of the insulating substrate 7 made from a ceramic and cap 10 which laid the SAW component K1 is carried out with insulating resin 9, it considers as the configuration in which insulating resin 6 does not infiltrate into the functional side in which the IDT electrode 5 was formed, and SAW equipment S1 is completed.

[0027] Moreover, connection with the electric conduction pattern 4 in which the conductor 12 and the connection object 3 of the piezo-electric substrate 1 were formed, and connection of the above-mentioned insulating substrate 7 may be made to coincidence by heating connection of insulating resin 6.

[0028] Moreover, the electric connection object 3 is not necessarily formed on the electric conduction pattern 4, but ** is also good and may prepare it in the SAW component K1 side. Hereafter, the configuration of each drawing is explained.

[0029] drawing 1 -4 -- the piezo-electric substrate 1 of the SAW component K1 -- penetration -- a conductor 12 is formed and it mounts in the insulating substrate 7 or the insulating package 14 which carries out a postscript according to face-up structure as well as [conventionally] structure.

[0030] Drawing 2 has die bond material and structure using the anisotropy electric conduction resin 13 which served as the role of a connection ingredient by the application of drawing 1 at connection of the SAW component K2 and the insulating package 14. Moreover, as anisotropy electric conduction resin 13, the epoxy resin in which the silver filler was made to mix is used. The lengthwise direction is made to produce a flow by using this anisotropy electric conduction resin 13. 15 is a lid which consists of a ceramic, resin metals (covar, 42 alloys, aluminum, Cu, etc.), etc. 14 is a package which consists of insulating ingredients,

such as a ceramic and resin. Adhesion immobilization of the insulation package 14 made from a ceramic and lid 15 which laid the SAW component K2 is carried out with the binders 16, such as seam welding or Au-Sn system solder, it considers as the configuration in which insulating resin does not infiltrate into the functional side in which the IDT electrode 5 was formed like before, and SAW equipment S2 is completed. In addition, you may mount with the structure using the insulating substrate 7 and cap 10 like drawing 1 .

[0031] Drawing 3 is SAW equipment S3 of the modification of drawing 2 , is the rear face of the piezo-electric substrate 1 about the I/O pad 2 of the SAW component K3, and has structure which the conductor pattern 4 which established the connection object 3 through the conductor 12 was made to flow electrically by ultrasonic concomitant use thermocompression bonding etc., connected with it, and carried out adhesion immobilization. This as well as drawing 1 may be mounted with the structure using the insulating substrate 7 and cap 10.

[0032] In order for insulating resin 6 to prevent trespassing upon a functional side so that drawing 4 may cover the IDT electrode 5 which constitutes the SAW component K4, After connecting the protective cover 17 which consists of a ceramic, resin, a metal, etc. by insulating resin etc. and connecting the SAW component K4 with the substrate 7 which consists of insulating ingredients, such as a ceramic and resin, by the same approach as drawing 1 , it has structure which carried out the mold of the insulating resin 6 to the whole SAW equipment S4 as a protective coat.

[0033] Thus, as for each of drawing 2 and SAW equipments of drawing 3 , alignment can drop a SAW component by self-alignment. As for drawing 1 - drawing 4 , the positive airtight structure to which insulating resin does not enter the oscillating space of an IDT electrode is obtained.

[0034] In drawing 1 - drawing 4 , by enclosing and sealing the air of low humidity in oscillating space, degradation by oxidation of the IDT electrode 5 can be controlled, and it is desirable. Moreover, the same effectiveness is acquired even

if it encloses and seals inert gas, such as nitrogen gas and argon gas, etc. instead of air.

[0035] In this invention, it consists of aluminum or an aluminum alloy (an aluminum-Cu system, aluminum-Ti system, etc.), and especially aluminum has high excitation effectiveness, and since ingredient cost is low, the IDT electrode 5 has it. [desirable] Moreover, although the configuration of the IDT electrode 5 has the shape of a ctenidium formed so that it might gear mutually, it may be the type which could apply also to the thing of a slit mold like a reflector which arranged two or more electrode fingers in parallel, and used them together.

[0036] And the width of face of 50 to about 200 and an electrode finger is suitable for the logarithm of the IDT electrode 5, when spacing of about 0.1-10.0 micrometers and an electrode finger acquires a property expected [as a resonator or a filter] in the crossover width of face of about 0.1-10.0 micrometers and an electrode finger setting thickness of about 10-80 micrometers and the IDT electrode 5 to about 0.2-0.4 micrometers. Moreover, if the reflector for reflecting SAW in the both ends of the propagation path of SAW of the IDT electrode 5, and resonating them efficiently may be prepared and piezoelectric material, such as ZnO, is further formed between electrode fingers, the resonance effectiveness of SAW improves and is suitable.

[0037] Moreover, if the reflector for reflecting SAW in the both ends of the propagation path of SAW of the IDT electrode 5, and resonating them efficiently may be prepared and piezoelectric material, such as ZnO, is further formed between electrode fingers, the resonance effectiveness of SAW improves and is suitable.

[0038] As a piezo-electric substrate for SAW components, it is LiTaO3 of 36 degreeY cut-X propagation. LiNbO3 of a single crystal and 64 degreeY cut-X propagation LiB 4O7 of a single crystal and 45-degreeX cut-Z propagation Since [that an electromechanical coupling coefficient is large and] the group delay temperature coefficient of a single crystal is small, it is desirable. Moreover, the thickness of a piezo-electric substrate has about 0.3-0.5 goodmm, a piezo-

electric substrate becomes weak in less than 0.3mm, and ingredient cost becomes large in 0.5mm **.

[0039] In this way, this invention can prevent completely an enter lump of the insulating resin to the oscillating space of SAW, and forms oscillating space certainly, does not have property degradation of SAW equipment, and has thin-shape-izing and the operation effectiveness that small lightweight is formed and manufacture by low cost is still attained.

[0040] In addition, this invention is not limited to the above-mentioned operation gestalt, and modification various by within the limits which does not deviate from the summary of this invention does not interfere at all.

[0041]

[Example] The surface acoustic wave equipment S1 shown in drawing 1 was constituted as follows. It is LiTaO3 of 36 degreeY cut-X propagation as a piezo-electric substrate for SAW components. The chip size was set to 1.1mmx1.5mm using the single crystal. Moreover, Au and nickel of a total of 1-micrometer thickness were formed for 3.0mmx3.0mm and an electric conduction pattern with nonelectrolytic plating as an insulating package. The insulating package used the package made from an alumina with a height of 0.8mm.

[0042] The connection object formed the wire of Au on the above-mentioned electric conduction pattern so that it might become a bump by the ball bonding method. This diameter of a bump set to 70 micrometers, and height was set to 50 micrometers.

[0043] After it processed the conductor prepared in the through tube penetrated to both the principal planes of a piezo-electric substrate using carbon dioxide laser and it formed the hole of 20 micrometers of apertures, it filled up with and formed the silver paste.

[0044] The connection between a bump and the conductor of a SAW component carried out imprint spreading of the thermosetting epoxy system electroconductive glue containing Ag at the bump 3, and carried out heating adhesion of a SAW component and the insulating substrate at 100 degrees C in

nitrogen-gas-atmosphere mind. Finally, heating adhesion of the cap was carried out to the insulating substrate at 150 degrees C with epoxy system adhesives.
[0045] The height of the surface acoustic wave equipment produced at such a process was set to 1.3mm. As mentioned above, the conventional wirebonding process was able to become unnecessary, the size of the space of the longitudinal direction of a wire and the height direction of a wire could be reduced, and miniaturization and thin shape-ization were able to be attained.
[0046] If RF-SAW filter is mounted in the conventional ceramic package, as compared with a bare chip element, the magnitude of attenuation by the side of a RF will deteriorate remarkably. Moreover, the damping property by the side of the low frequency in a passband may deteriorate with a filter specification. This is considered to be the effect by the inductance component of a package and Au wire. By applying flip chip mounting, it is thought that the frequency characteristics of the filter near a bare chip element property are acquired.
[0047]
[Effect of the Invention] Since it connected through the conductor which prepared the input/output terminal connected to the conductor pattern on a base, and the excitation electrode of a surface acoustic element in the through tube penetrated to both the principal planes of a piezo-electric substrate according to the surface acoustic wave equipment of this invention as explained in full detail above Since the airtight of the oscillating space of a surface acoustic wave can be formed certainly, surface acoustic wave equipment excellent in the dependability which prevented completely the enter lump of the insulating resin to oscillating space, dust, etc., and prevented property degradation as much as possible can be offered.
[0048] Moreover, since a piezo-electric substrate is laid and it fixes in the insulating substrate which has the almost same area of base as a piezo-electric substrate, or an insulating package, thin-shape-izing and a miniaturization can be attained, and when laying a piezo-electric substrate in an insulating package, the surface acoustic wave equipment which can be mounted with a sufficient

precision by self-alignment can be offered.

[0049] furthermore -- since it can mount with face-up structure, after connecting -- an appearance etc. -- it can inspect -- manufacture -- easy surface acoustic wave equipment can be offered.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the end view for explaining typically 1 operation gestalt of the surface acoustic wave equipment concerning this invention.

[Drawing 2] It is the end view for explaining typically other operation gestalten of the surface acoustic wave equipment concerning this invention.

[Drawing 3] It is the end view for explaining typically other operation gestalten of the surface acoustic wave equipment concerning this invention.

[Drawing 4] It is the end view for explaining typically other operation gestalten of the surface acoustic wave equipment concerning this invention.

[Drawing 5] It is the end view for explaining conventional surface acoustic wave equipment typically.

[Drawing 6] It is the end view for explaining other conventional surface acoustic

wave equipments typically.

[Description of Notations]

1: A piezo-electric substrate

2: Pad

3: Connection object (bump)

4: Electric conduction pattern

5: IDT electrode

6: Insulating resin

7: An insulating substrate (base)

8: Electrode lead pattern

9: Insulating resin

10: Cap

11: Oscillating space

12: Conductor

13: Anisotropy electric conduction resin

14: An insulating package

15: Lid (lid)

16: Lid connection object

17: Protective cover

K1 - a K4:SAW component

S1 - S4:SAW equipment

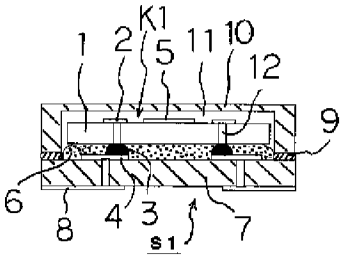
[Translation done.]

2.**** shows the word which can not be translated.

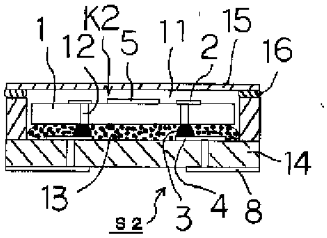
3.In the drawings, any words are not translated.

DRAWINGS

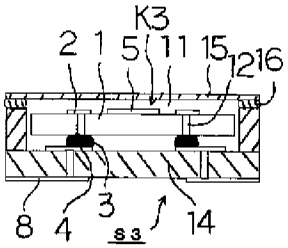
[Drawing 1]



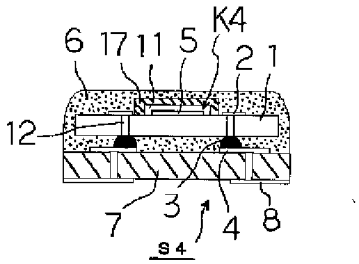
[Drawing 2]



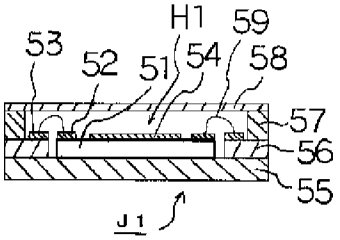
[Drawing 3]



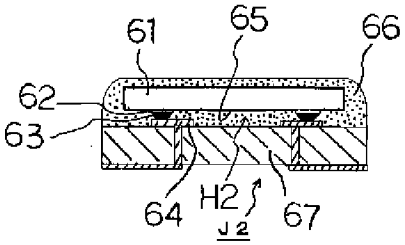
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]